

# MARYLAND

## Contact Information

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## Program Description

The Maryland Biological Stream Survey (MBSS) is a program of the Maryland Department of Natural Resources (MD DNR) and is intended to provide statistically unbiased estimates of the condition of first through third-order (wadeable) non-tidal streams and rivers of Maryland on a local (e.g., drainage basin or county) as well as a statewide scale. The survey is based on a probabilistic stream sampling approach where random selections are made from all streams in the state that can physically be sampled. The approach supports statistically valid population estimation of variables of interest (e.g., largemouth bass densities, miles of streams with degraded physical habitat, miles of streams with poor Index of Biotic Integrity scores, etc.). When repeated, the Survey will also provide a basis for assessing future changes in ecological condition of flowing waters of the state. At present, plans are to repeat the Survey at regular intervals and expand the approach to larger streams and tidal creeks.

Benthic macroinvertebrates and water quality samples are collected during the spring index period from March through early May, while fish, herpetofauna, *in situ* stream chemistry, and physical habitat sampling are conducted during the low flow period in the summer, from June through September.

Data collected from each sample site are used to develop statewide and basin-specific estimates of totals, means (or averages), proportions, and percentiles for the parameters of interest. The amount of variability (or margin of error) associated with any estimate of a total, mean, proportion, or percentile is determined by calculating a standard error, a statistic that measures the reliability of an estimate. A standard error also provides a statistical basis for deciding if the observed changes in any parameter of interest over time or space are significantly different or simply due to chance alone.

## Documentation and Further Information

2000 Maryland Section 305(b) Water Quality Report, with Appendix E, Assessment Methodology:  
[http://dnrweb.dnr.state.md.us/download/bays/MD2000\\_305b.pdf](http://dnrweb.dnr.state.md.us/download/bays/MD2000_305b.pdf)

DRAFT 2002 Integrated 303(d) List: [http://www.mde.state.md.us/tmdl/2002\\_303dlist/index.html](http://www.mde.state.md.us/tmdl/2002_303dlist/index.html)

From the Mountains to the Sea: The State of Maryland's Freshwater Streams, December 1999:  
<http://www.dnr.state.md.us/streams/pubs/md-streams.pdf>

Maryland Biological Stream Survey (MBSS) Sampling Manual, February 2000:  
[http://www.dnr.state.md.us/streams/pubs/2000samp\\_manual.pdf](http://www.dnr.state.md.us/streams/pubs/2000samp_manual.pdf)

MBSS Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy, November 2000:  
[http://www.dnr.state.md.us/streams/pubs/ea00-6\\_lab\\_man.pdf](http://www.dnr.state.md.us/streams/pubs/ea00-6_lab_man.pdf)

Refinement and Validation of a Fish Index of Biotic Integrity (IBI) for Maryland Streams, October 2000:  
[http://www.dnr.state.md.us/streams/pubs/ea00-2\\_fibi.pdf](http://www.dnr.state.md.us/streams/pubs/ea00-2_fibi.pdf)

Development of a Benthic Index of Biological Integrity for Maryland Streams, December 1998:  
[http://www.dnr.state.md.us/streams/pubs/1998\\_Benthic%20IBI.pdf](http://www.dnr.state.md.us/streams/pubs/1998_Benthic%20IBI.pdf)

For more documents and publications, go to: [http://www.dnr.state.md.us/streams/mbss/mbss\\_pubs.html](http://www.dnr.state.md.us/streams/mbss/mbss_pubs.html) or  
[http://www.dnr.state.md.us/streams/pubs/pub\\_list.html](http://www.dnr.state.md.us/streams/pubs/pub_list.html)

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## Programmatic Elements

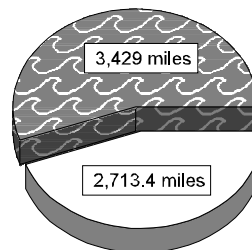
<b>Uses of bioassessment within overall water quality program</b>	✓	problem identification (screening)
	✓	nonpoint source assessments
	✓	monitoring the effectiveness of BMPs ( <i>LIMITED</i> )
	✓	ALU determinations/ambient monitoring ( <i>LIMITED</i> )
	UD	promulgated into state water quality standards as biocriteria ( <i>through MDE</i> )
	✓	support of antidegradation
	✓	evaluation of discharge permit conditions ( <i>LIMITED</i> )
	✓	TMDL assessment and monitoring ( <i>MDE using MBSS data</i> )
	✓	other: target restoration costs and locations; areas for preservation; track trends in stream conditions; identify relationships between stressors and biota; predict future conditions based on land use changes
<b>Applicable monitoring designs*</b>	✓	targeted ( <i>small portion - special projects and specific river basins or watersheds</i> )
	✓	fixed station (i.e., water quality monitoring stations) ( <i>sentinel site network, best of the best streams in the state, comprehensive use throughout jurisdiction</i> )
	✓	probabilistic by stream order/catchment area ( <i>comprehensive use throughout jurisdiction</i> )
	✓	probabilistic by ecoregion, or statewide ( <i>comprehensive use throughout jurisdiction</i> )
	✓	rotating basin ( <i>comprehensive use throughout jurisdiction</i> )
		other:



\*The largest portion of sampling effort is for probabilistic sampling with watershed as primary strata.

### Stream Miles

<b>Total miles</b>	<b>17,000</b>
<i>(determined using National Hydrography Database)</i>	
Total perennial miles	12,343
<b>Total miles assessed for biology**</b>	<b>6,142</b>
fully supporting for 305(b)	3,429.0
partially/non-supporting for 305(b)	2,713.4
listed for 303(d)**	178 actual listings
number of sites sampled ( <i>from 1995-1997</i> )	1,000
number of miles assessed per site	—

### 6,142 Miles Assessed for Biology



-  "fully supporting" for 305(b)
-  "partially/non-supporting" for 305(b)

\*\*The miles listed above were extracted from Maryland's 2000 305(b) Report, which stated, "The assessment of non-tidal rivers and streams is based on monitoring data, including ambient water quality monitoring programs and other water quality data collected by [various agencies and programs]." The above miles are categorized as "monitored" in the 2000 305(b). However, the MBSS method only applies to *wadeable* nontidal streams, thus some portion of the total assessed stream and river miles listed above were not assessed using this method. The 178 sites listed for 303(d) were pulled from the DRAFT 2002 303(d) Report. These miles do not include streams larger than 4<sup>th</sup> order or with tidal flow.

## Aquatic Life Use (ALU) Designations and Decision-Making

<b>ALU designation basis</b>	Single Aquatic Life Use, Fishery Based Uses, Warm Water vs. Cold Water	
<b>ALU designations in state water quality standards</b>	Seven uses: I: support of fish & aquatic life and recreation; I-P: adds drinking water supply to Use I; II: shellfish harvesting; III: natural trout; III-P: adds drinking water supply; IV: recreational trout (put and take); IV-P: adds drinking water.	
<b>Narrative Biocriteria in WQS</b>	Narrative regulations and formal/informal numeric procedures specifically addressing biocriteria applications are under development.	
<b>Numeric Biocriteria in WQS</b>	none - documented quantitative method applied	
<b>Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)</b>	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges ( <i>RARELY</i> )
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
<b>Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU</b>	Threatened and Endangered species listings are being revised based on MBSS fish population data; cost estimates for habitat restoration in MD streams are being finalized in support of Chesapeake Bay 2000 Agreement action items; MBSS data integral to developing restoration priority ranking for MD watersheds; also used by The Nature Conservancy to develop highest priority watersheds for land acquisition and other preservation activities	

## Reference Site/Condition Development

<b>Number of reference sites</b>	<b>152 total</b>	
<b>Reference site determinations</b>	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: use combination of <i>a priori</i> physical and chemical criteria applied to randomly selected sites - these represent the best remaining sites in Maryland
<b>Reference site criteria</b>	Must meet <i>a priori</i> chemical and physical criteria (criteria found in MBSS IBI documents for fish and benthos)	
<b>Characterization of reference sites within a regional context</b>	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
<b>Stream stratification within regional reference conditions</b>	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input checked="" type="checkbox"/>	other: reference sites stratified by stream order
<b>Additional information</b>	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

## Field and Lab Methods

<b>Assemblages assessed</b>	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	fish (100-500 samples/year; single season, multiple sites - watershed level)
	<input type="checkbox"/>	periphyton
	<input checked="" type="checkbox"/>	other: macrophytes and amphibians/reptiles (presence/absence only) (100-500 samples/year; single season, multiple sites - watershed level)
<b>Benthos</b>		
sampling gear		D-frame; 500-600 micron mesh
habitat selection		multihabitat, focus on most productive habitat - riffles
subsample size		100 count
taxonomy		genus (family level taxonomy for volunteer Stream Waders Program)
<b>Fish</b>		
sampling gear		backpack electrofisher, barge shocker sometimes used on larger streams, herpetile search also conducted by hand; 1/4" mesh
habitat selection		whatever is in the 75 meter segment
sample processing		length measurement and biomass – batch (gamefish only); anomalies (unusual types or prevalence noted)
subsample		none
taxonomy		species
<b>Habitat assessments</b>		
		visual based, quantitative measurements, buffer width and vegetation size category, linear and areal extent of eroded banks; performed with bioassessments
<b>Quality assurance program elements</b>		
		standard operating procedures; quality assurance plan; periodic meetings/ training for biologists; sorting and taxonomic proficiency checks; specimen archival; double entry of data; range checks; peer review of reports; certification program for bioassessment

## Data Analysis and Interpretation

<b>Data analysis tools and methods</b>	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics ( <i>aggregate metrics into an index</i> )
	<input checked="" type="checkbox"/>	disturbance gradients
	<input checked="" type="checkbox"/>	other: various, depending on needs
<b>Multimetric thresholds*</b>		
transforming metrics into unitless scores		50 <sup>th</sup> percentile of reference population
defining impairment in a multimetric index		10 <sup>th</sup> percentile used as threshold between metric scores of 3 and 1; confidence intervals used to evaluate sample results for attainment decisions
<b>Multivariate thresholds</b>		
defining impairment in a multivariate index		For development of IBI; not current analysis
<b>Evaluation of performance characteristics</b>	<input checked="" type="checkbox"/>	repeat sampling ( <i>see IBI documents plus interim biocriteria document produced by MDE</i> )
	<input checked="" type="checkbox"/>	precision ( <i>replicate sample/same team, same reach</i> )
	<input checked="" type="checkbox"/>	sensitivity ( <i>classification efficiency</i> )
	<input type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy ( <i>classification efficiency</i> )
	<input checked="" type="checkbox"/>	other: re-sort in laboratory
<b>Biological data</b>		
Storage		MS Access, SAS primarily, but also use spreadsheets for some applications (data dictionaries are produced for external users - see MBSS publications page)
Retrieval and analysis		SAS, Excel, Quattro pro, ARC View

\*Fish and Benthic IBIs are also combined into a "Combined Biological Index."